# Progress Toward a Nationwide Ground-Water Monitoring Network


***William L. Cunningham***
***Co-chair, ACWI Subcommittee on Ground Water***
***U.S. Geological Survey***




***Robert P. Schreiber***
***Non-Federal Co-Chair***
***CDM***

***Christine Reimer***
***Executive Secretary***
***National Ground Water Association***


***National Water Quality Monitoring Council***
***March 11, 2009***

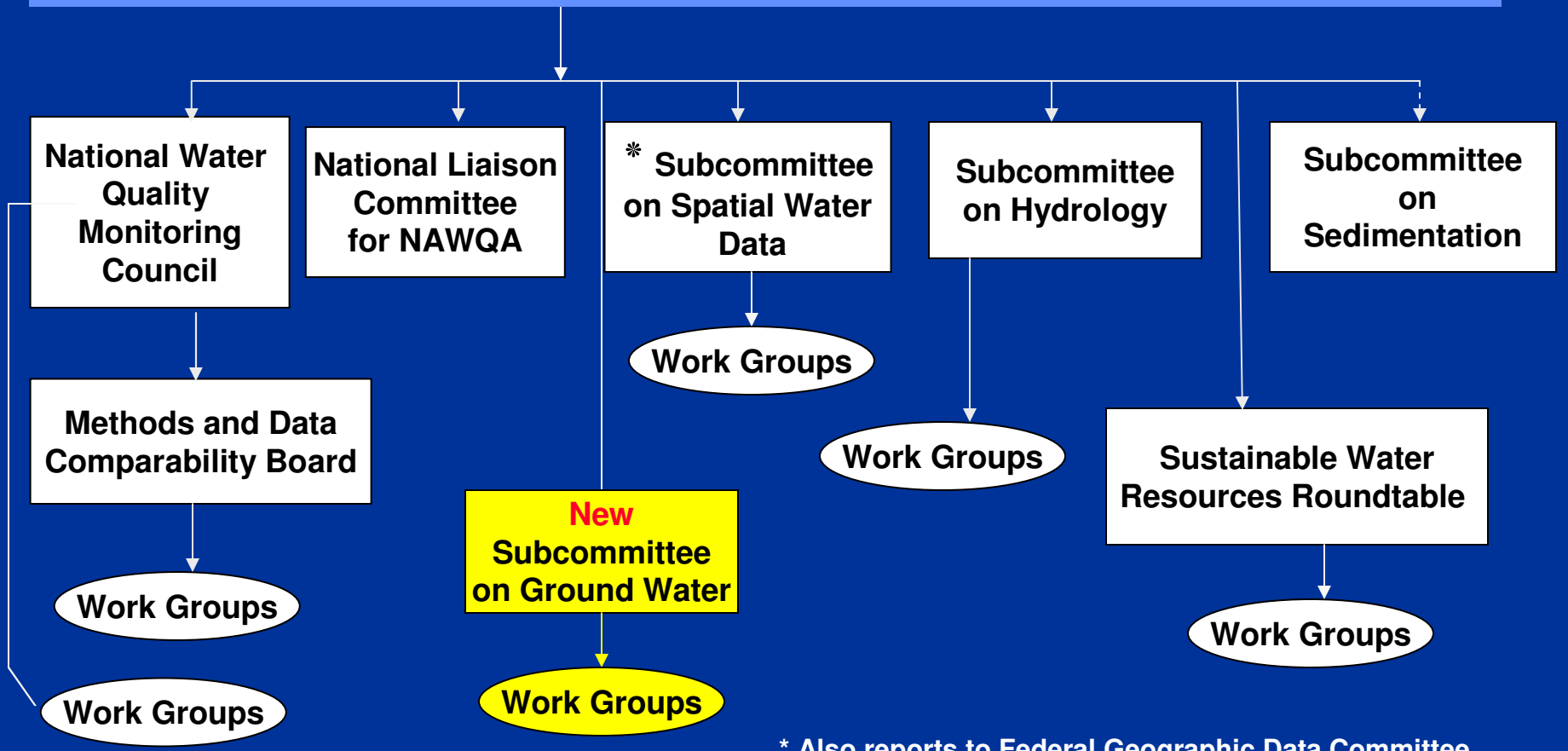
# Presentation Outline

- ACWI Subcommittee on Ground Water
- Framework for a Nationwide Ground-Water Monitoring Network
- A Product to Build on
- Opportunities for Interaction with the Coastal Monitoring Network

WICP Water Information Coordination Program

ACWI Advisory Committee on Water Information

# ACWI GROUPS




* Also reports to Federal Geographic Data Committee

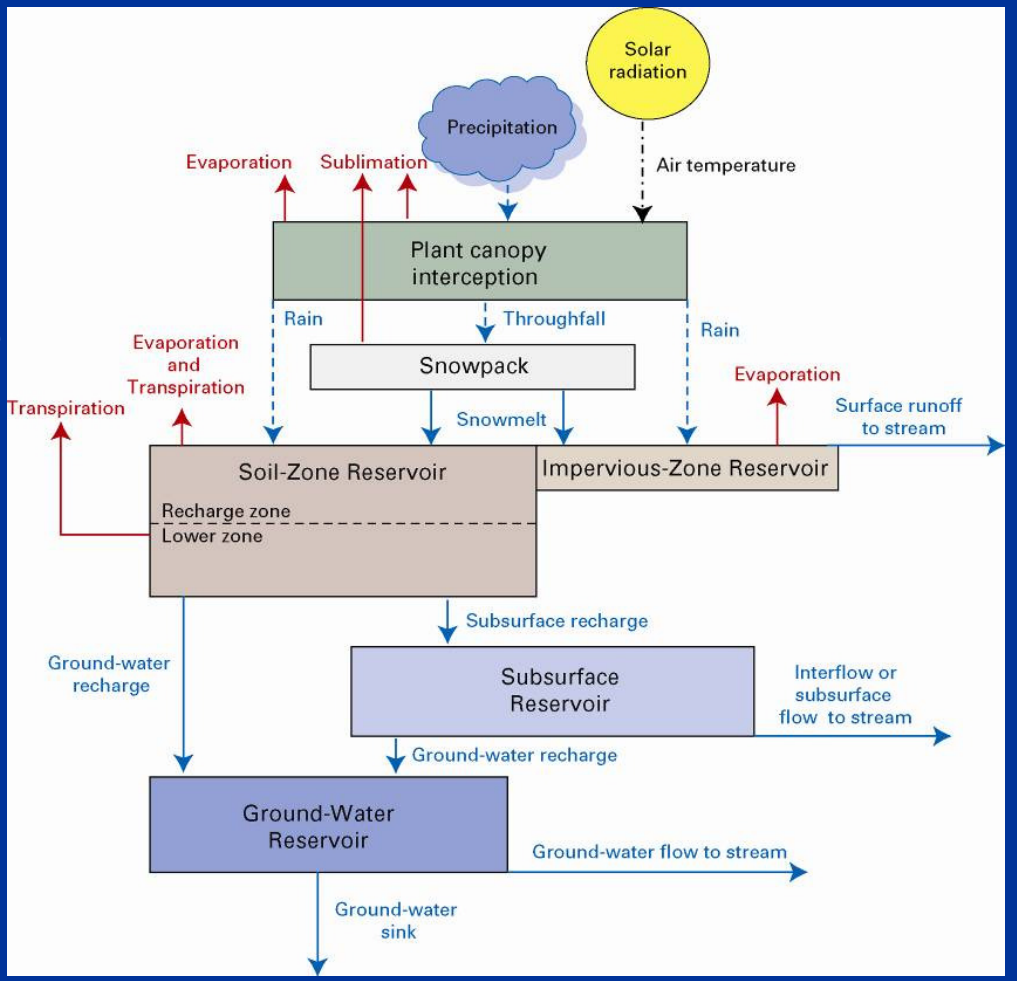
# Drivers for a Nationwide Network

- 2003 GAO Report
  - 36 states expecting shortages
- SWAQ Report calling for a "Water Census"
- Heinz Center Reports on the "State of the Nation's Ecosystems"
  - Ground-water data are "*inadequate for national reporting*"
- Coastal Monitoring Network

# Comprehensive Water Monitoring

## Interest in "one place for water data"

- Atmospheric water
- Unsaturated Zone
- Surface-water discharge
- Surface-water quality
- Ground-water levels
- Ground-water quality



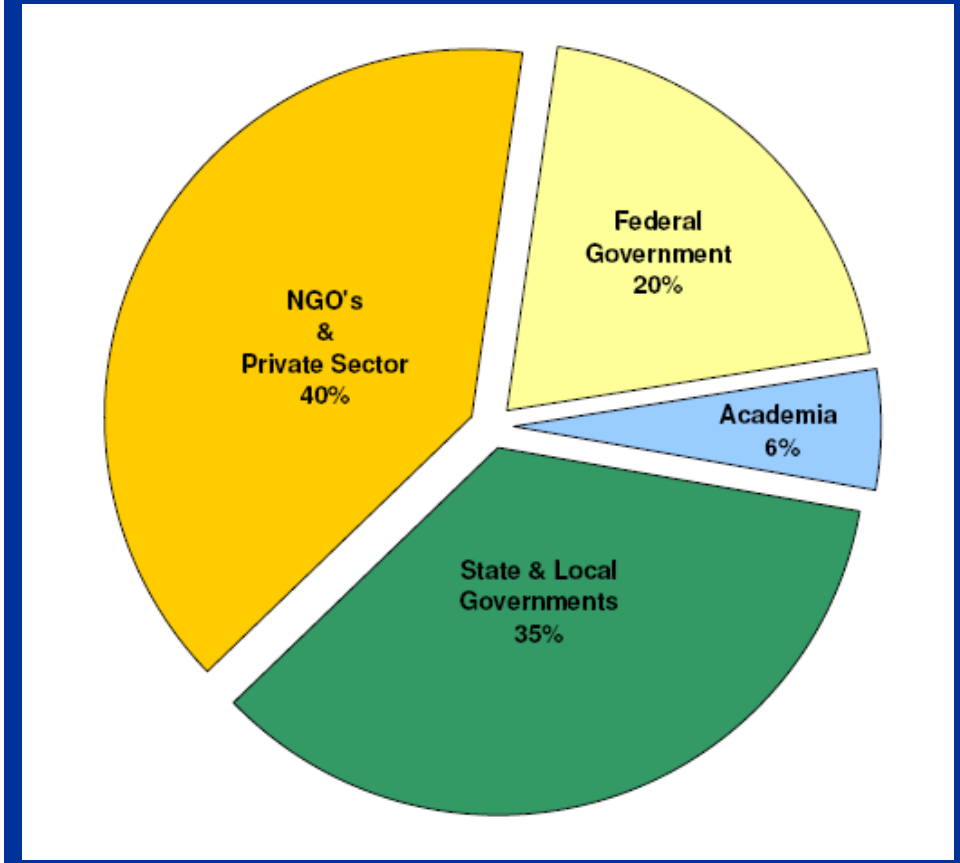
# ACWI Charge to SOGW

Purpose: "…develop and encourage implementation of a nationwide, long-term ground-water quantity and quality monitoring framework that would provide information necessary for the planning, management, and development of ground-water supplies to meet current and future water needs, and ecosystem requirements."

Scope: "…will be developed to assist in assessments of the quantity of U.S. ground-water reserves, as constrained by ground- water quality."

# SOGW Members & Helping Hands

Subcommittee and Work Groups:
**70** people from **54** organizations



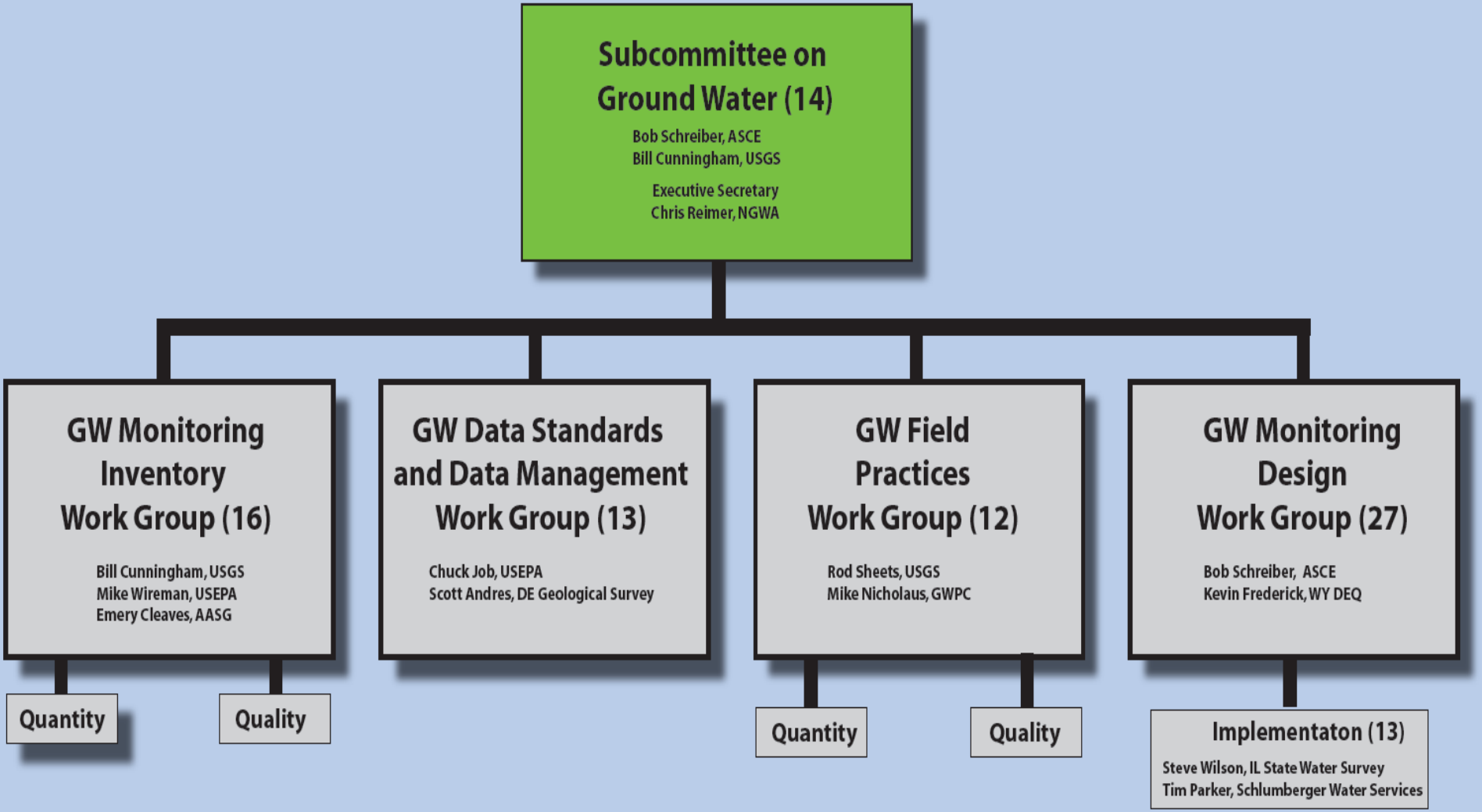

## Subcommittee Members

- American Society of Civil Engineers
- Ground Water Protection Council
- Interstate Council on Water Policy
- Association of American State Geologists
- National Ground Water Association
- Texas Commission on Environmental Quality
- US Geological Survey
- USEPA Headquarters and Region 8
- Association of State Drinking Water Administrators
- Water Environment Federation
- USDA Forest Service
- Association of State and Interstate Water Pollution Control Administrators
- ASTM

# SOGW Approach

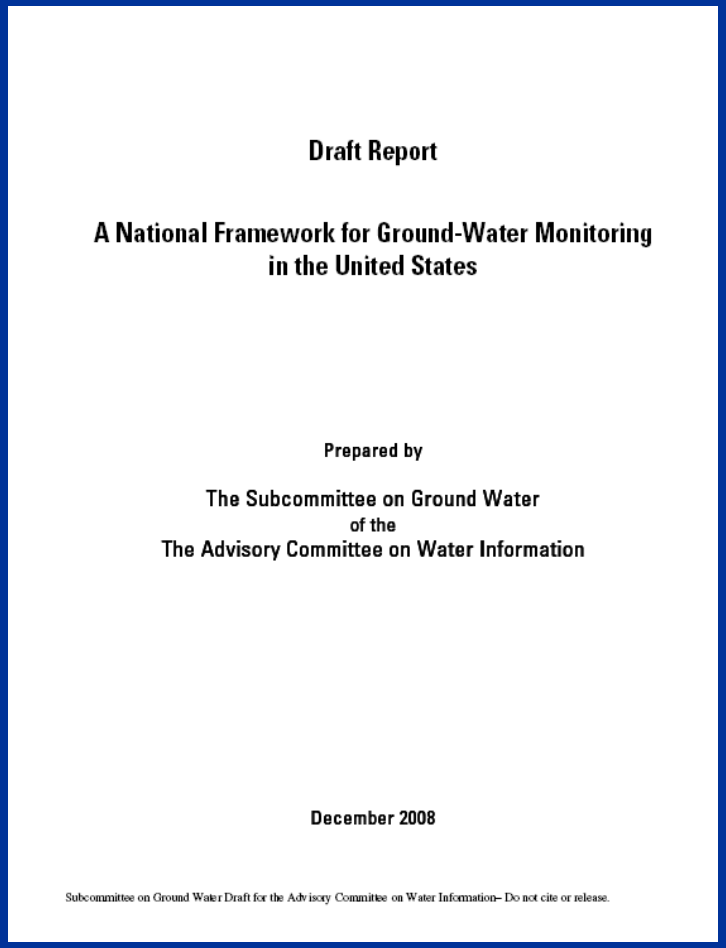
- Determine “current picture” of ground-water monitoring
- Consensus network design principles
- Consensus field methods and data standards
- Determine approach for compiling data
- Consensus implementation plan

# SOGW Work Groups



# Framework Report to ACWI

- Available to NWQMC in Jan 2009
- Report approved by the ACWI in February 2008
- Available at http://acwi.gov/sogw/pubs



Draft Report

A National Framework for Ground-Water Monitoring in the United States

Prepared by

The Subcommittee on Ground Water
of the
The Advisory Committee on Water Information

December 2008

Subcommittee on Ground Water Draft for the Advisory Committee on Water Information– Do not cite or release.

# ACWI Resolution, Feb 2009

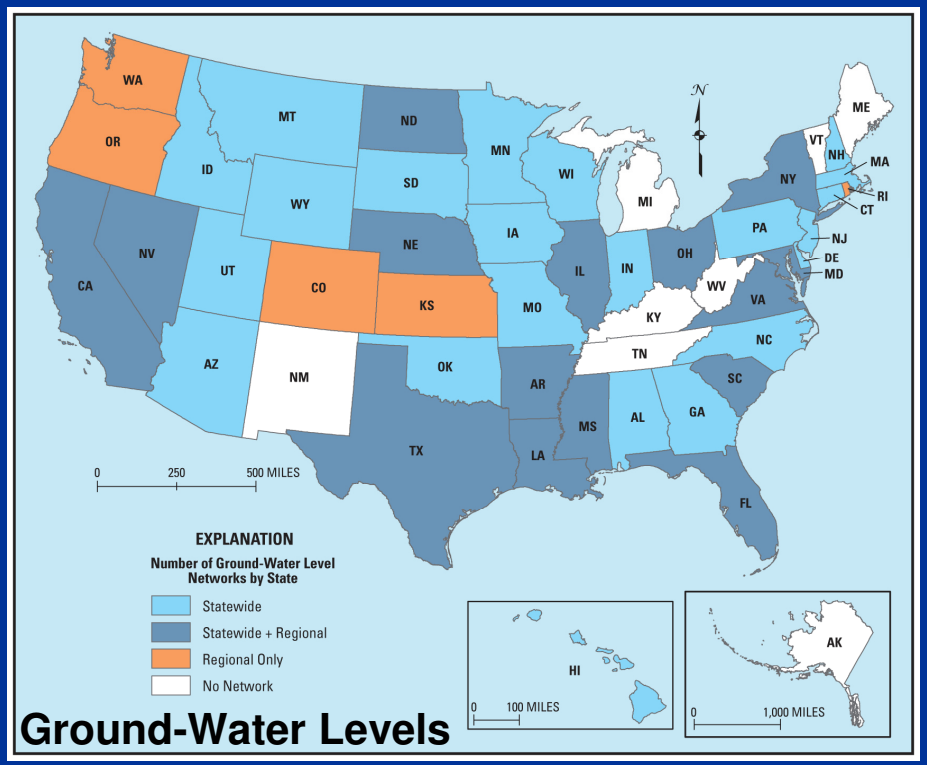
***Now Therefore Be it Resolved that…….***

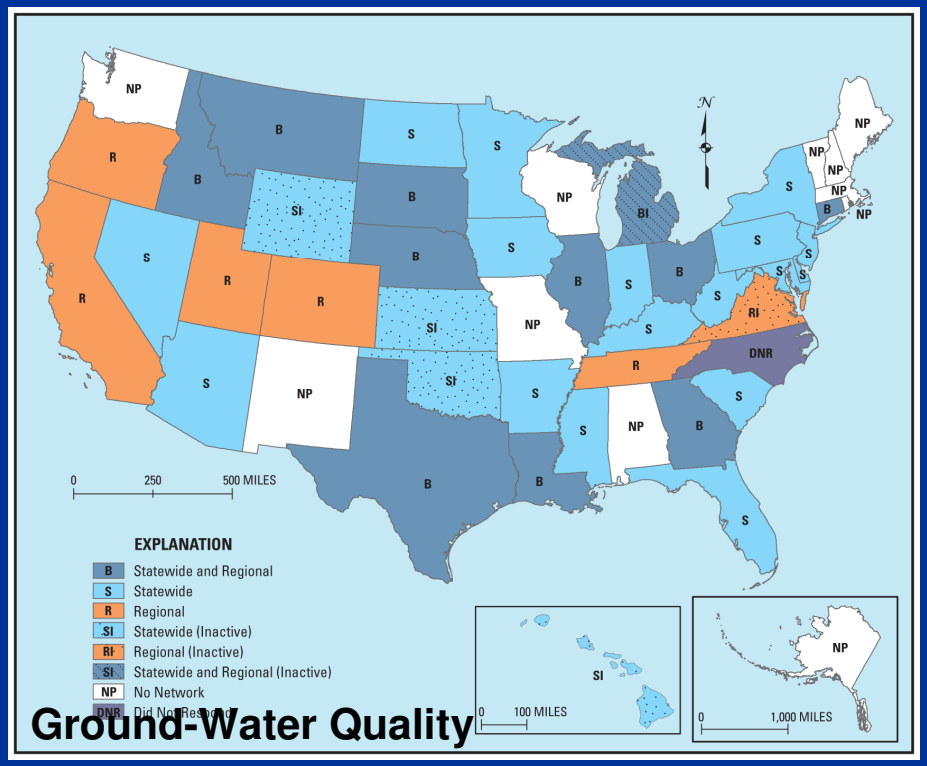
- **ACWI accepts the Framework Document,**
- **ACWI adopts the conceptual implementation plan for the National Ground Water Monitoring Network, and**
- **ACWI charges SOGW to move forward with development and initiation of pilot testing, patterned after the preceding efforts related to the National Water Quality Monitoring Network for U.S. Coastal Waters and Their Tributaries.**

# Inventory of Monitoring Programs:

## *State Networks*

- "Patchwork Quilt" of networks
- 42 States have statewide or regional water-level network, 32 have statewide or regional water-quality network




*State/Regional Ground Water Monitoring Network Report-2007. Joint project of AASG, GWPC, ICWP and NGWA*

# Inventory of Monitoring Programs:
## *Water Levels*

| # of States | Type |
|---|---|
| 22 | One or more statewide networks |
| 15 | One or more statewide and regional networks |
| 5 | One or more regional networks |
| 8 | No statewide or regional network |
| 50 | Total states |

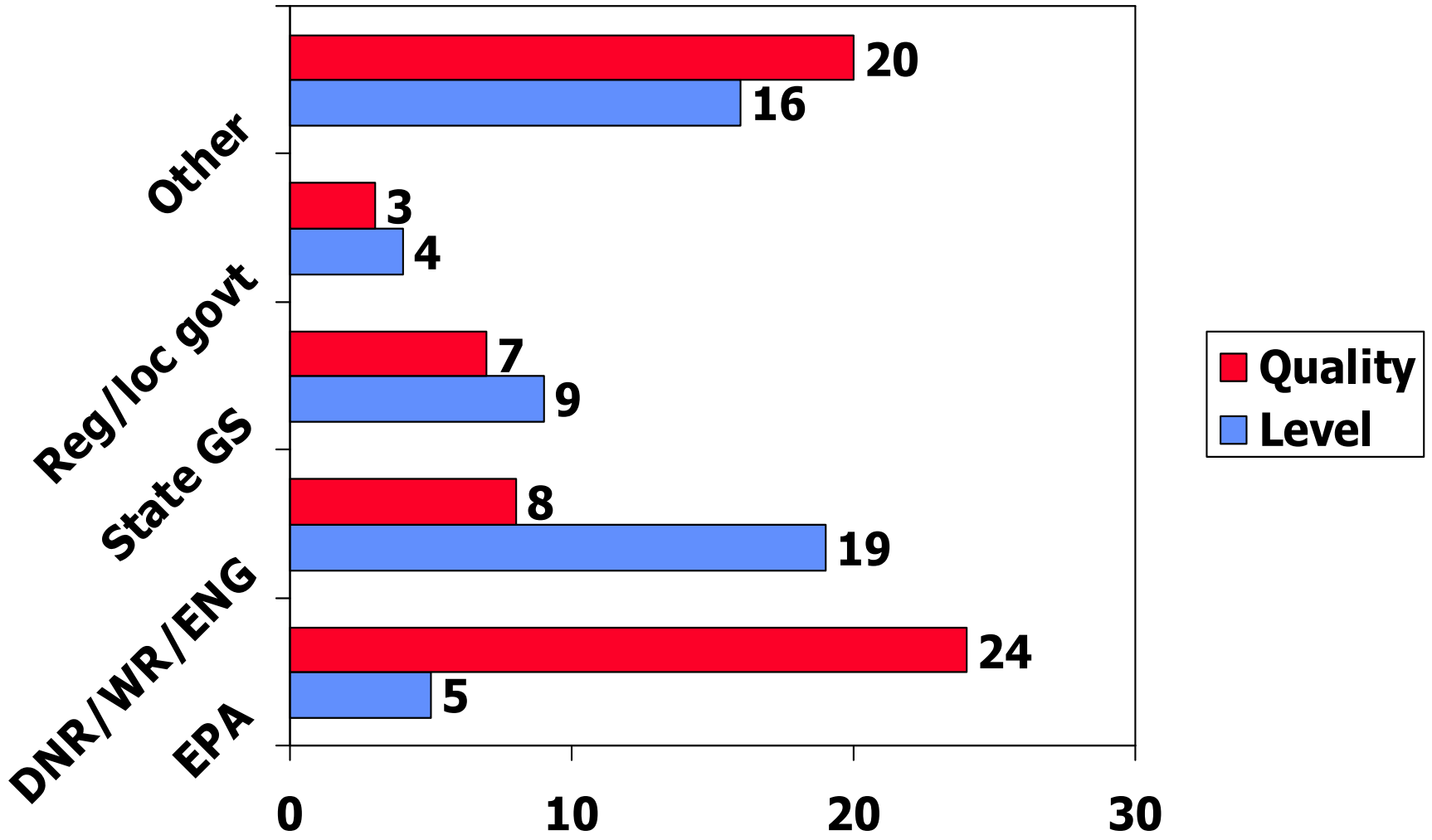
**State/Regional Ground Water Monitoring Network Report-2007. Joint project of AASG, GWPC, ICWP and NGWA and information from USGS*

# Inventory of Monitoring Programs:
## *Water Quality ("ambient")*

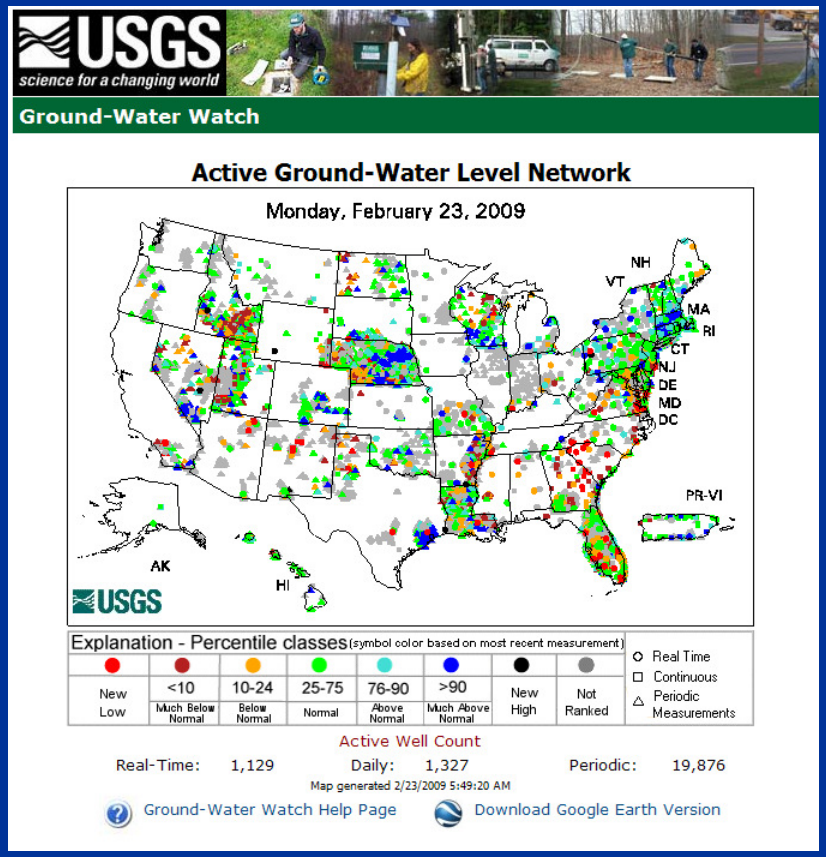
| # of States | Type Program |
|---|---|
| 17 | One or more statewide networks |
| 10 | One or more statewide and regional networks |
| 5 | One or more regional networks |
| 11 | No statewide or regional network |
| 5 | Inactive either statewide or regional |
| 1 | No response |
| 50 | Total states |

**State/Regional Ground Water Monitoring Network Report-2007. Joint project of AASG, GWPC, ICWP and NGWA*

# Inventory of Monitoring Programs:
## *Network Management*



# Inventory of Monitoring Programs:
## *Federal Networks*





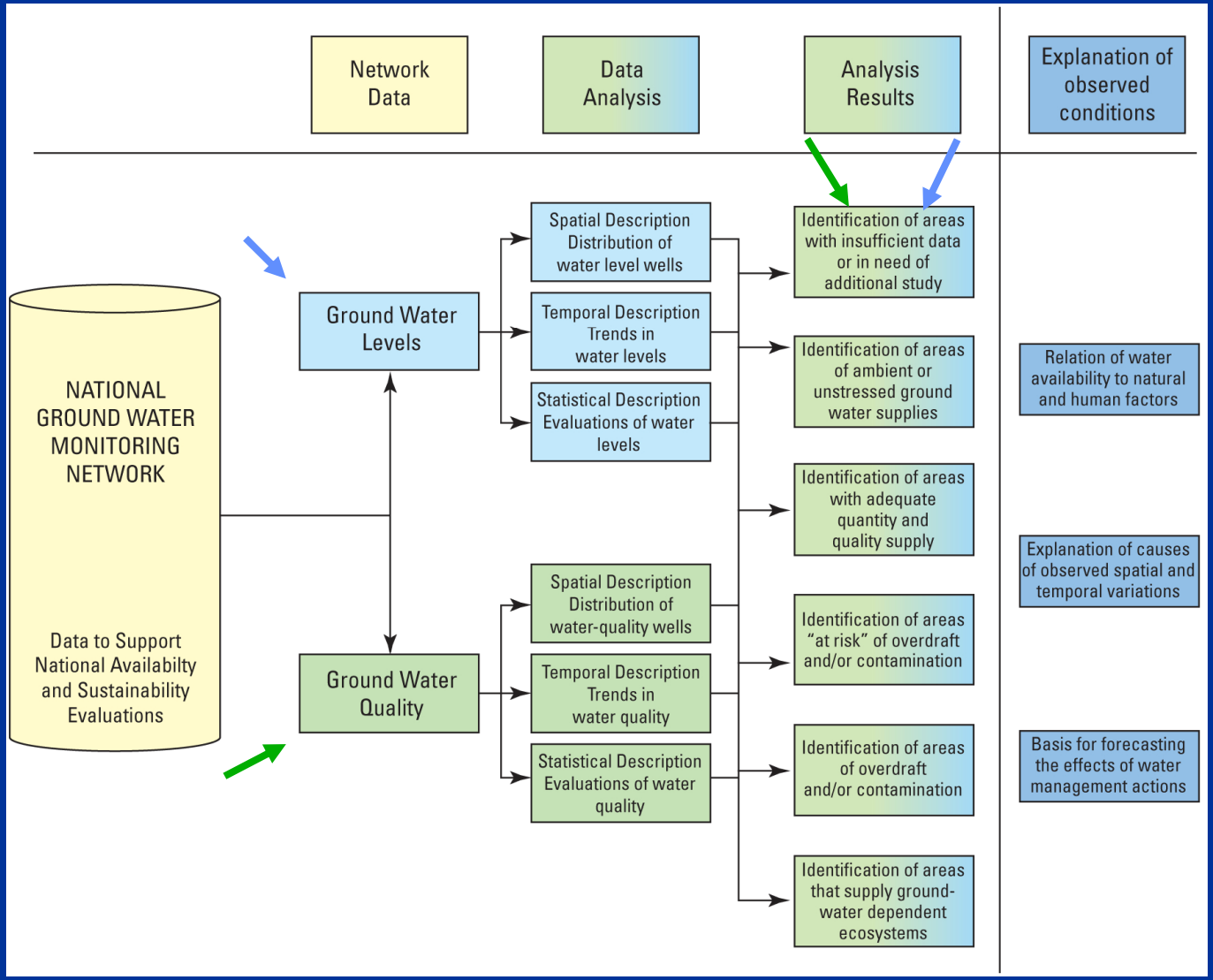


# Summary of Existing Monitoring

- Many networks already exist
- Multiple agencies involved, sometimes multiple agencies within a state
- Ambient level networks more prevalent than quality networks
- National gaps in both
- Gap analysis work to be done

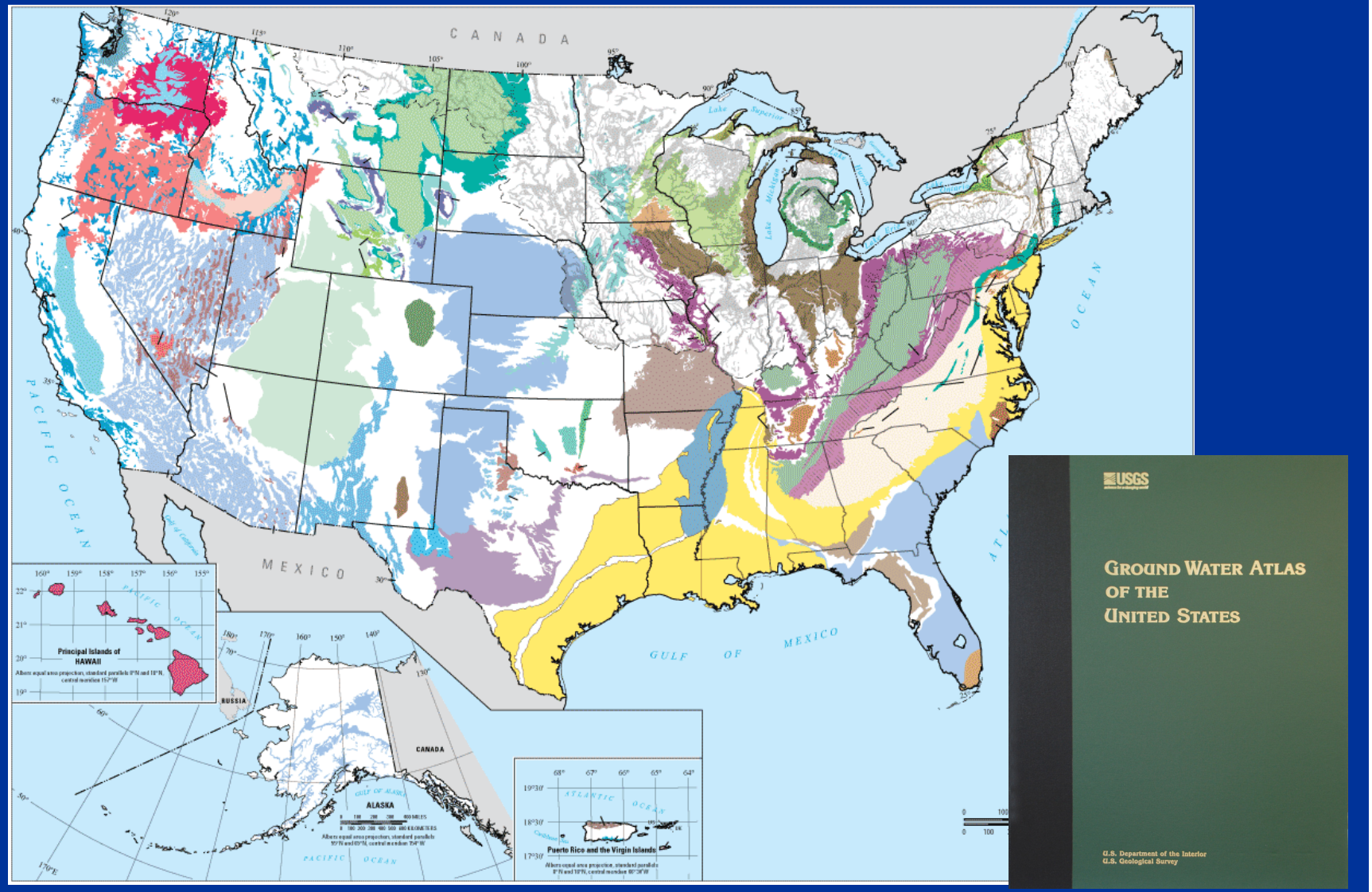
# Network Goals and Design:

## *Relation between Levels and Quality*

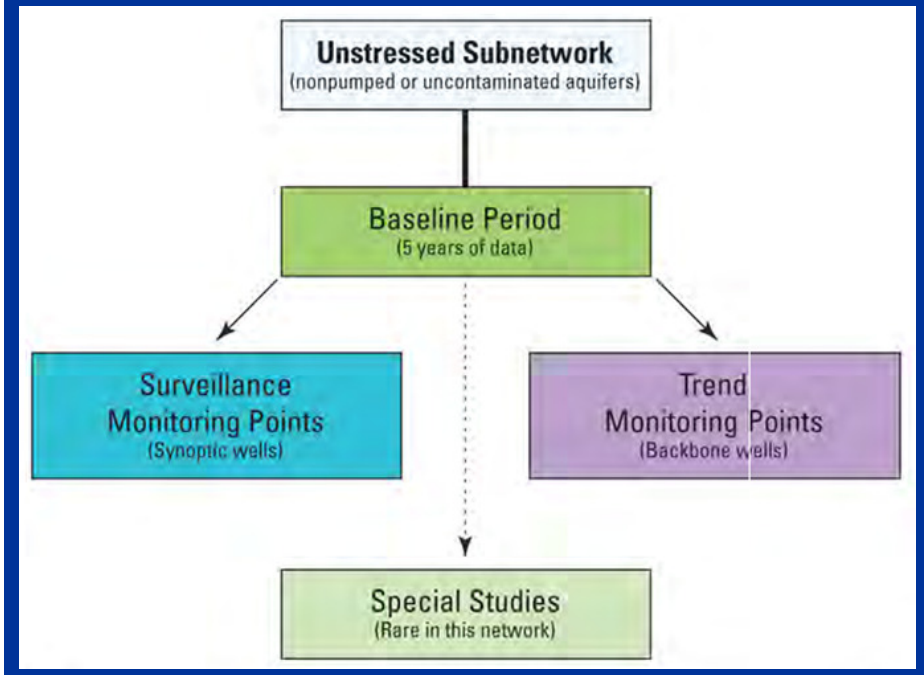


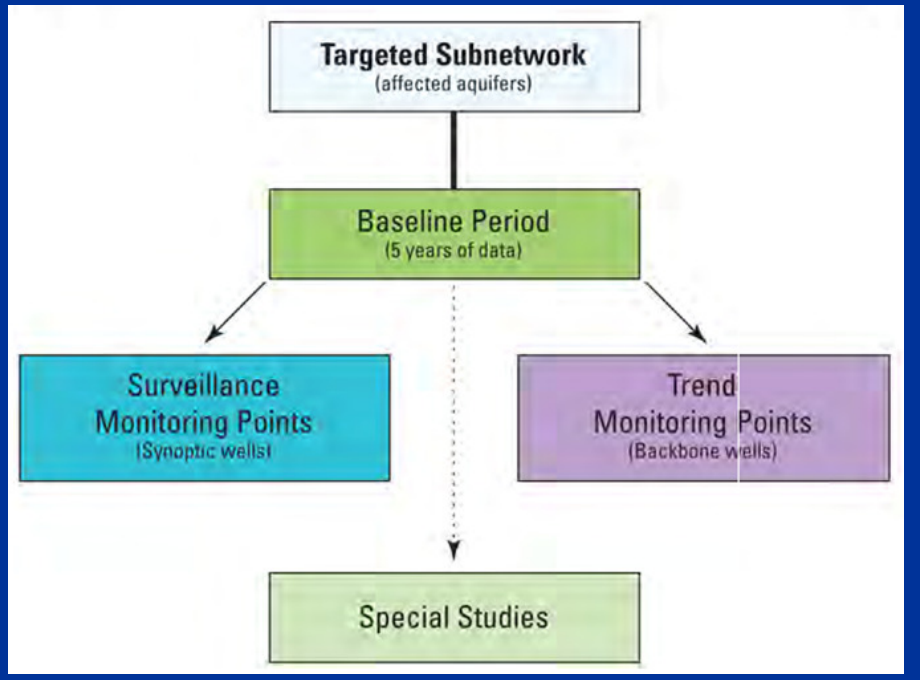
# Network Goals and Design:

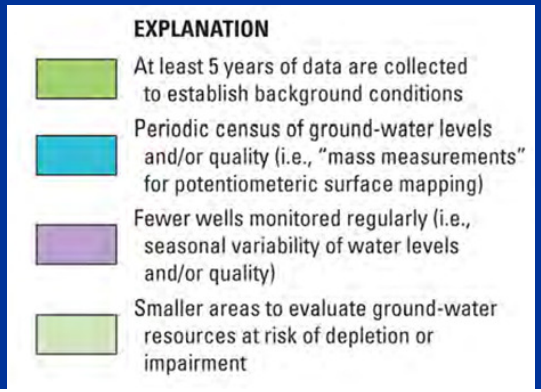
## *Principal and Major Aquifers*



# Network Goals and Design:
## *Types of Networks*

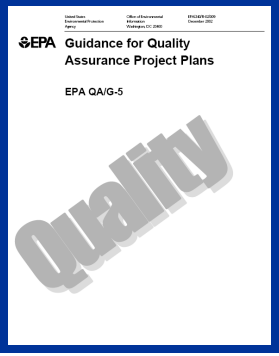


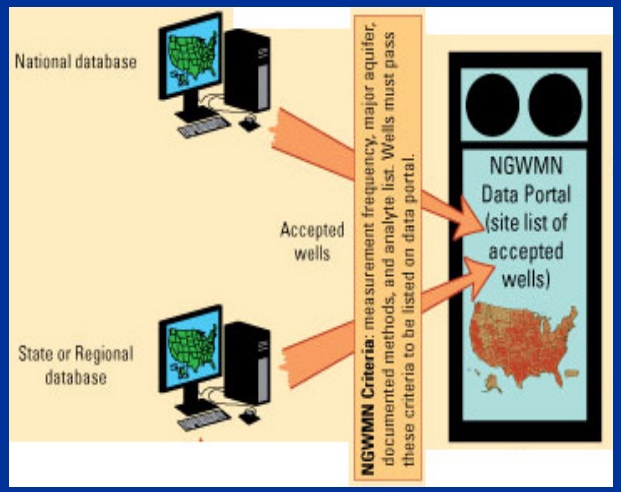
# Comparable Field Practices:
## *Levels and Quality*

- Few strict requirements--flexible and adaptable.
- Requires documentation of techniques to ensure comparability and assure quality in ground-water measurement and sampling activities.
- New technologies will be incorporated into the NGWMN as appropriate.



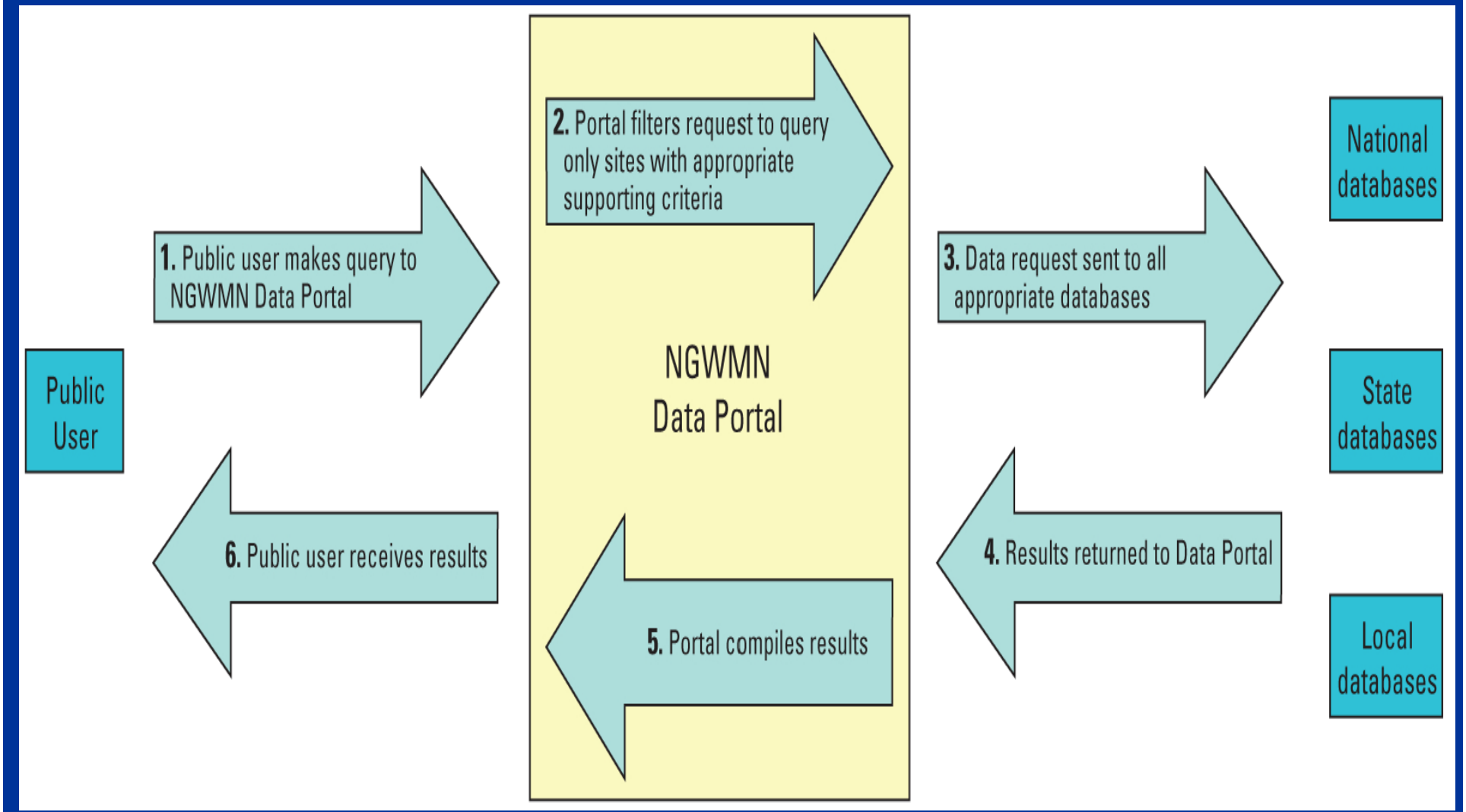

# Comparable Data Standards and Management

- Minimum Data Elements for wells and measurements are provided*
- A Data Portal is **the most critical component**, and needed early in the process




* Methods Board

# Data Management:
## *Proposed Data Portal*



# Network Implementation:
## *A Stepwise Approach*

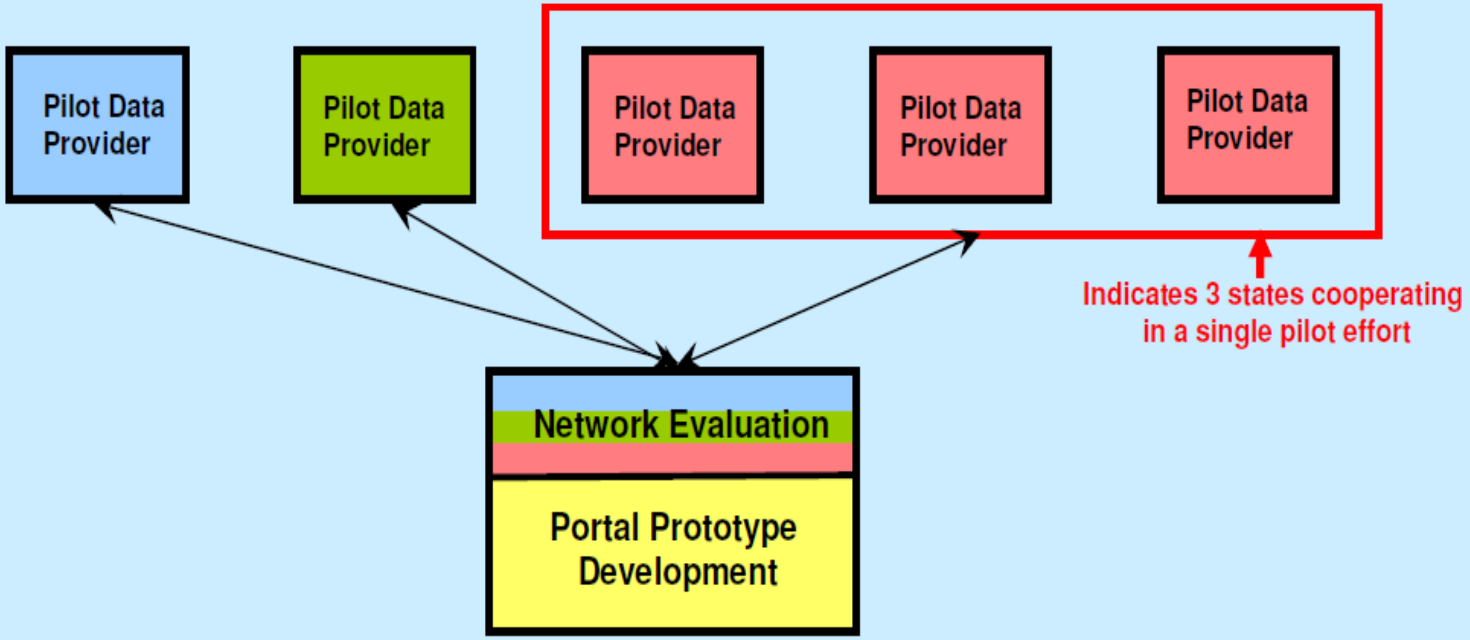
- Initiate Pilot Programs
- Develop Portal System
- Establish Management Structure
- Federal funding needed to facilitate participation by data providers

# Network Implementation:
## *Pilot Program Goals*

**Within the Framework Goals:**

- **Begin Gap Analysis**
- **Pilot selections should evaluate one or more water-level network, water-quality network, and/or combinations thereof**
- **Selections should include a variety of "robustness"**
- **Interact with EPA, USGS, and one or more State databases in order to develop a ground-water data portal**
- **Report out and improve Framework**

# Network Implementation:
## *"Draft" Pilot Approach*



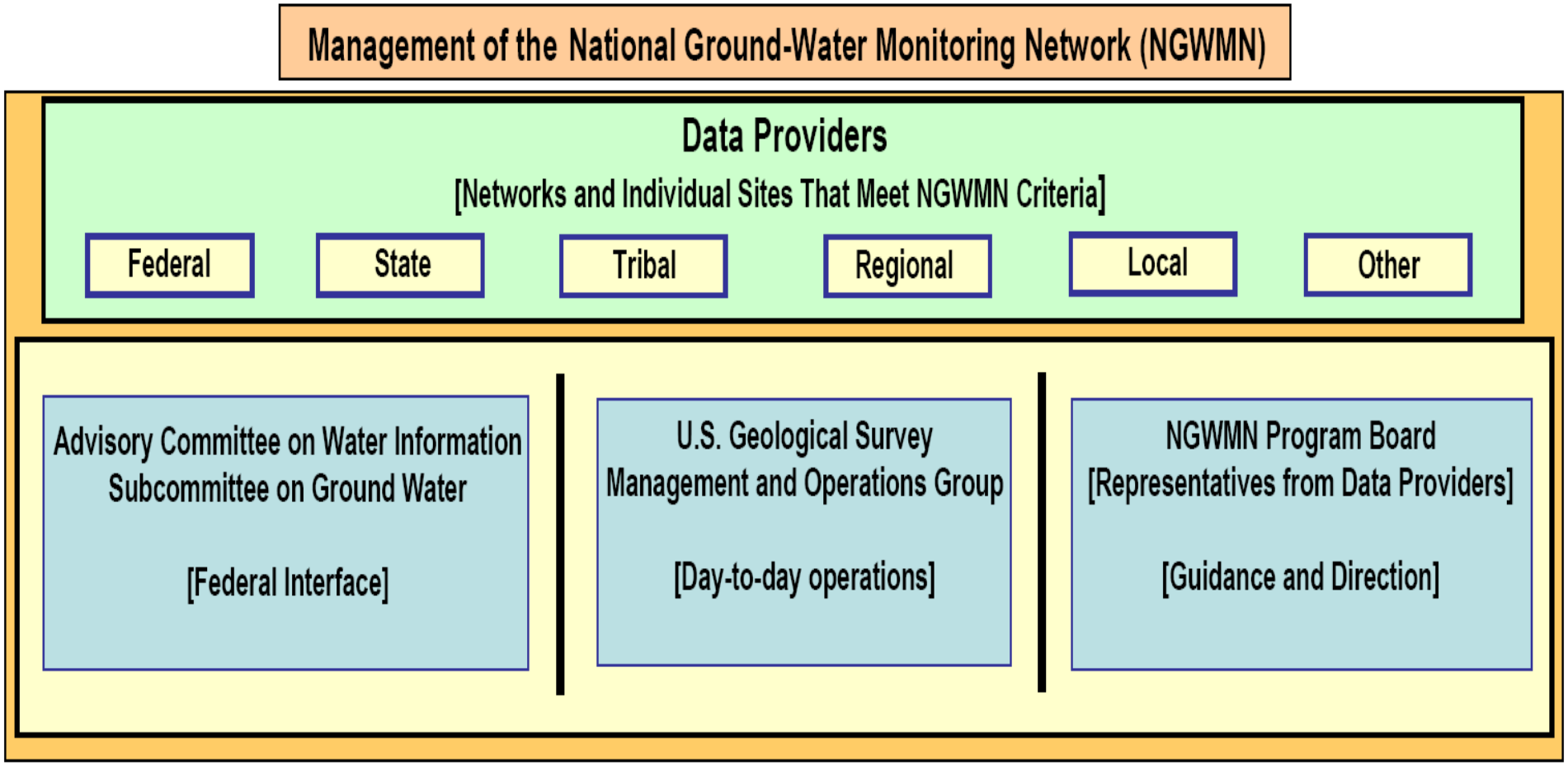

### Data Providers

1. **Information Technology**: Work with internal database and with Portal developer to ensure that data can flow from data provider to the portal.
2. **Hydrogeologist**: Evaluate data provider network with respect to the principles outlined in the Framework Document.
3. **Hydrogeologist**: Work with the Subcommittee on Ground Water to adjust the Framework, or work internally to adjust internal network, methods, or standards.
4. **Hydrogeologist and IT Staff**: Write Pilot report.

### Portal Development

1. **Information Technology**: Develop hardware and software for prototype Ground-Water Data Portal to serve water levels and water quality.
2. **Hydrogeologist and IT Staff**: Work with Data Providers to ensure that data can flow from Data Provider database to prototype Portal.
3. **Hydrogeologist**: Work with the Subcommittee on Ground Water to adjust the Framework as needed, or work internally to adjust the Portal.
4. **Hydrogeologist and IT Staff**: Document the portal in a "report" using on-line tools.

# Network Implementation:
## *Recommended Management Structure*



# A Example Product to Address GW Questions…..

- What are baseline ground-water levels?
- How are ground-water levels changing with time?
- By well?  By Aquifer?

# USGS Ground-Water Watch

USGS science for a changing world

USGS Home
Contact USGS
Search USGS

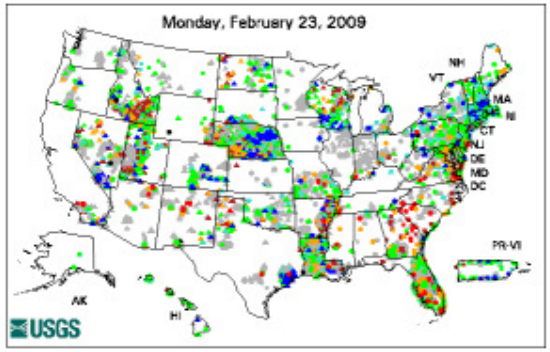
**Ground-Water Watch**

## USGS Ground-Water Networks

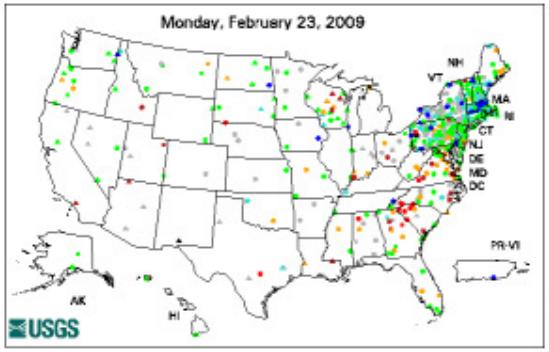
The USGS has a distributed water database that is locally managed. Surface water, ground water, and water quality data are rolled up from these local, distributed databases into a national information system. The ground-water database contains records from about 850,000 wells that have been compiled during the course of ground-water hydrology studies over the past 100 years. Information from these wells is served via the Internet through NWISWeb, the National Water Information System Web Interface. NWISWeb provides all USGS ground-water data that are approved for public release. This large number of sites is excellent for some uses, but complicates retrievals when the user is interested in specific networks, or wells in an active water-level measurement program.

These web sites group related wells and data from these active well networks, and provide basic statistics about the water-level data collected by USGS water science centers for Cooperative Program, Federal Program, and supplied to us by our customers through cooperative agreements.

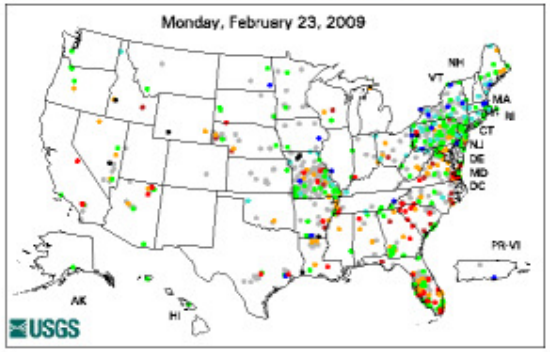
**Active Ground-Water Level Network**




**Climate Response Network**

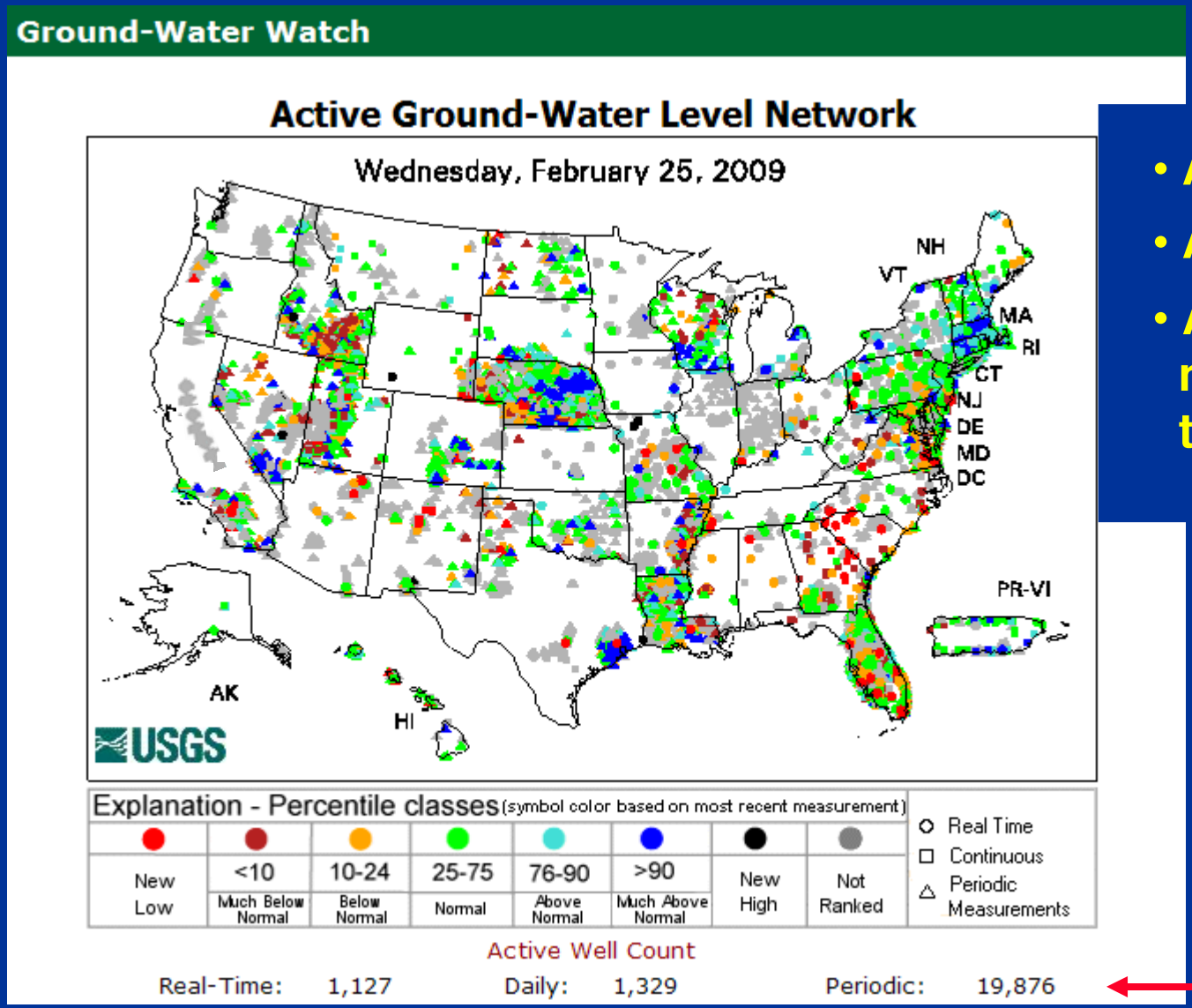



**Real-Time Ground-Water Level Network**



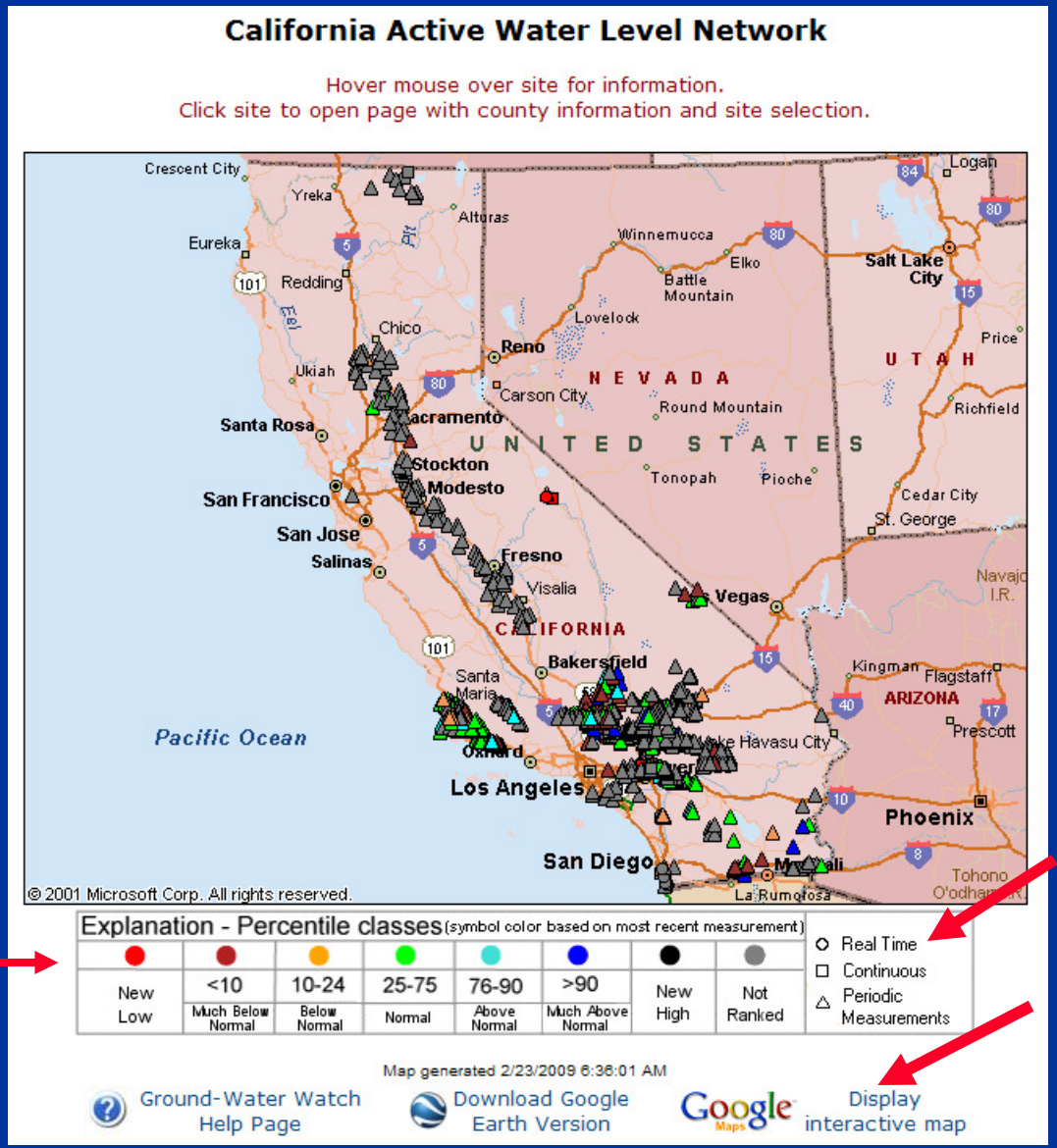

http://groundwaterwatch.usgs.gov

# Active Water-Level Network




- Any aquifer
- Any frequency
- At least one measurement within the last year

# State Pages

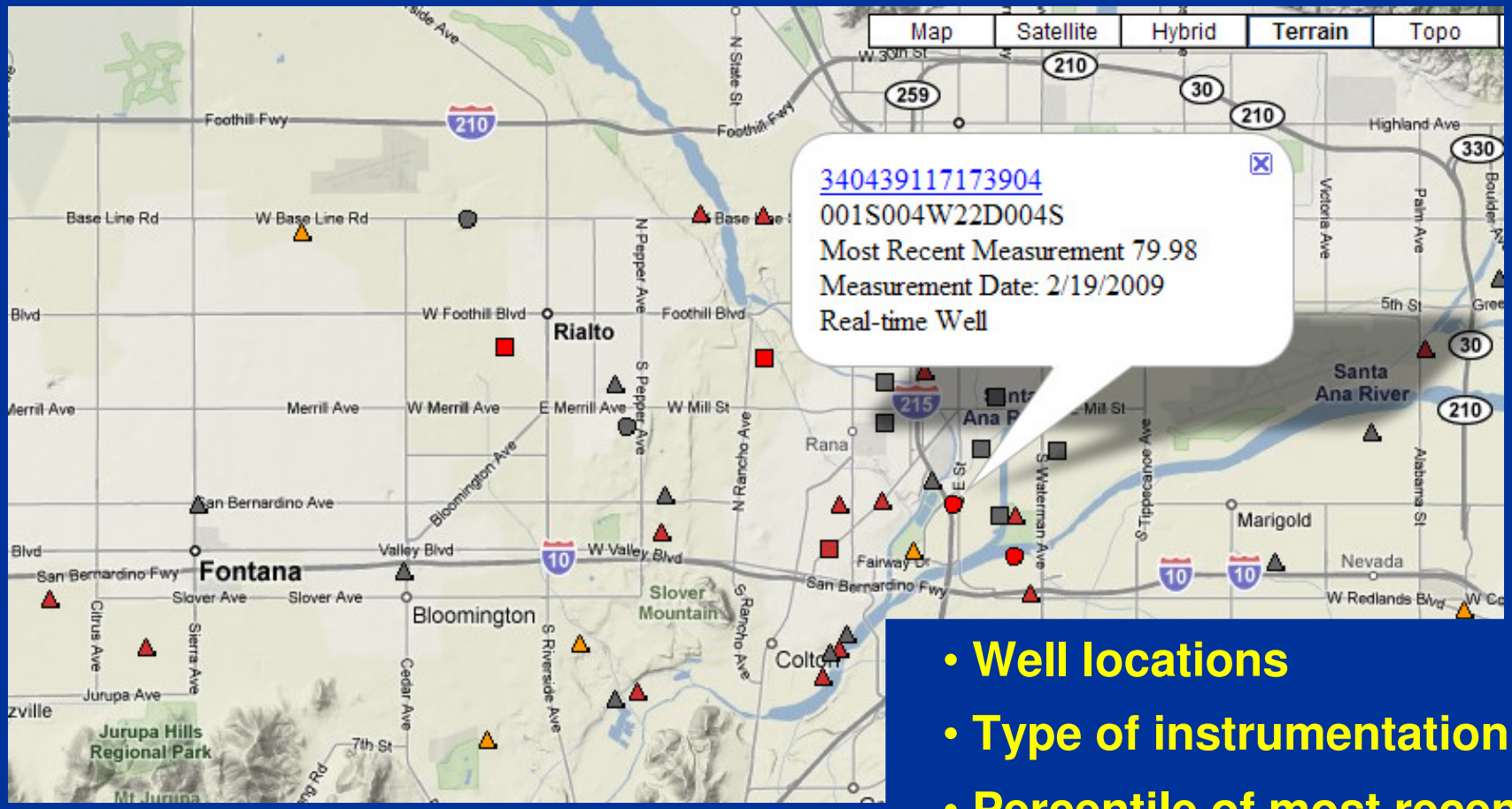



- Well locations
- Table of Wells per County
- Type of instrumentation
- Percentile of most recent measurement
- Map options

**California Counties depicted on the state location map with active wells**

| Counties | Well Count | Real-Time | Continuous | Periodic |
|---|---|---|---|---|
| Alameda County | 6 | - | - | 6 |
| Butte County | 6 | - | - | 6 |
| Colusa County | 4 | - | - | 4 |
| Fresno County | 28 | - | - | 28 |
| Glenn County | 11 | - | - | 11 |
| Imperial County | 55 | - | - | 55 |
| Inyo County | 11 | - | - | 11 |
| Kern County | 95 | - | - | 95 |
| Kings County | 3 | - | - | 3 |
| Los Angeles County | 168 | - | - | 168 |
| Madera County | 6 | - | - | 6 |
| Merced County | 13 | - | - | 13 |
| Modoc County | 5 | - | 2 | 3 |
| Mono County | 3 | 1 | 1 | 1 |
| Orange County | 9 | - | - | 9 |

# County Pages

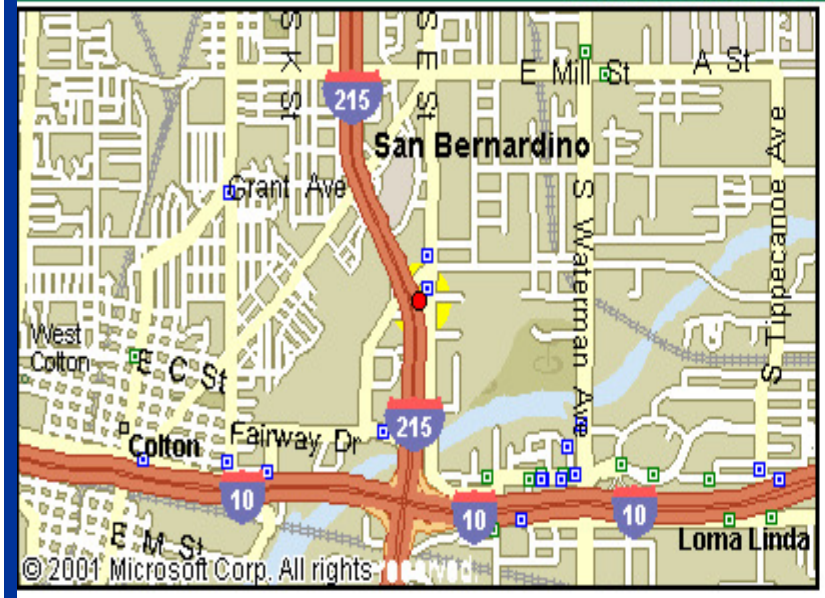



- Well locations
- Type of instrumentation
- Percentile of most recent measurement
- Some well information

# Site Pages: Site Info

## Ground-Water Watch

Site Number: 340439117173904 - 001S004W22D004S




Ground-Water Watch Help Page

**DESCRIPTION:**

Latitude 34°04'38.65", Longitude 117°17'42.53" NAD83
San Bernardino County, California, Hydrologic Unit 18070203
Land surface altitude: 977.44feet above sea level NAVD88.

**AVAILABLE DATA FROM NWISWeb:**

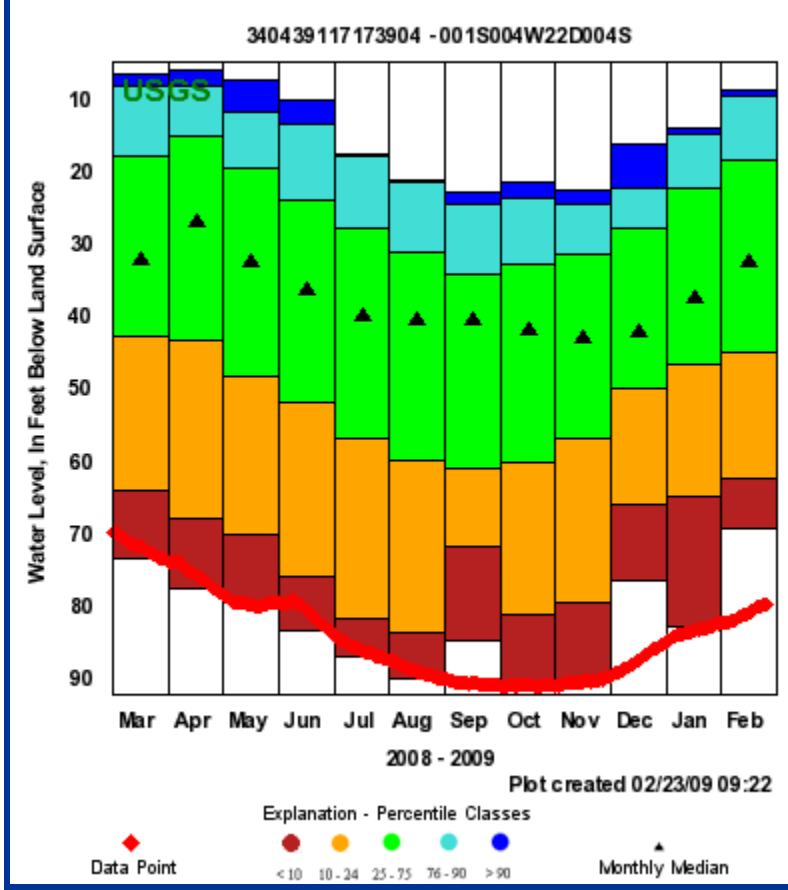
**Real-time**
**Daily Data**
**Field ground-water-level measurements**
**Field/Lab water-quality samples**

**OPERATION:**

Record for this site is maintained by the USGS California Water Science Center
Email questions about this site to California Water-Data Inquiries

# Site Pages: Monthly Statistics

## Site Statistics




**Most recent data value: 79.62 on 2/22/2009**
**Period of Record Monthly Statistics for 340439117173904**
**Depth to water level, feet below land surface**
**All Approved Continuous & Periodic Data Used In Analysis**
**Note: Bold values in the table indicate closest statistic to the most recent data value.**

| Month | Lowest Level | 10th %ile | 25th %ile | 50th %ile | 75th %ile | 90th %ile | Highest Level | Number of Years |
|---|---|---|---|---|---|---|---|---|
| Jan | 82.70 | 64.84 | 46.70 | 37.49 | 22.27 | 14.70 | 13.84 | 18 |
| Feb | **69.33** | 62.34 | 45.06 | 32.58 | 18.36 | 9.54 | 8.76 | 18 |
| Mar | 73.31 | 64.04 | 42.68 | 32.12 | 17.90 | 8.27 | 6.58 | 18 |
| Apr | 77.45 | 67.83 | 43.16 | 26.92 | 15.08 | 8.10 | 5.85 | 17 |
| May | 79.42 | 70.18 | 48.29 | 32.37 | 19.38 | 11.72 | 7.22 | 17 |
| Jun | 83.33 | 75.78 | 51.70 | 36.48 | 24.05 | 13.34 | 10.03 | 18 |
| Jul | 86.88 | 81.70 | 56.77 | 39.89 | 27.75 | 17.71 | 17.65 | 17 |
| Aug | 89.97 | 83.54 | 59.84 | 40.46 | 31.09 | 21.56 | 21.05 | 18 |
| Sep | 84.81 | 71.84 | 60.96 | 40.56 | 34.22 | 24.38 | 22.76 | 17 |
| Oct | 91.15 | 81.03 | 60.11 | 41.86 | 32.80 | 23.75 | 21.52 | 18 |
| Nov | 90.35 | 79.51 | 56.84 | 43.00 | 31.52 | 24.36 | 22.58 | 19 |
| Dec | 76.42 | 65.80 | 49.78 | 42.27 | 27.74 | 22.19 | 16.09 | 18 |

Statistics Options

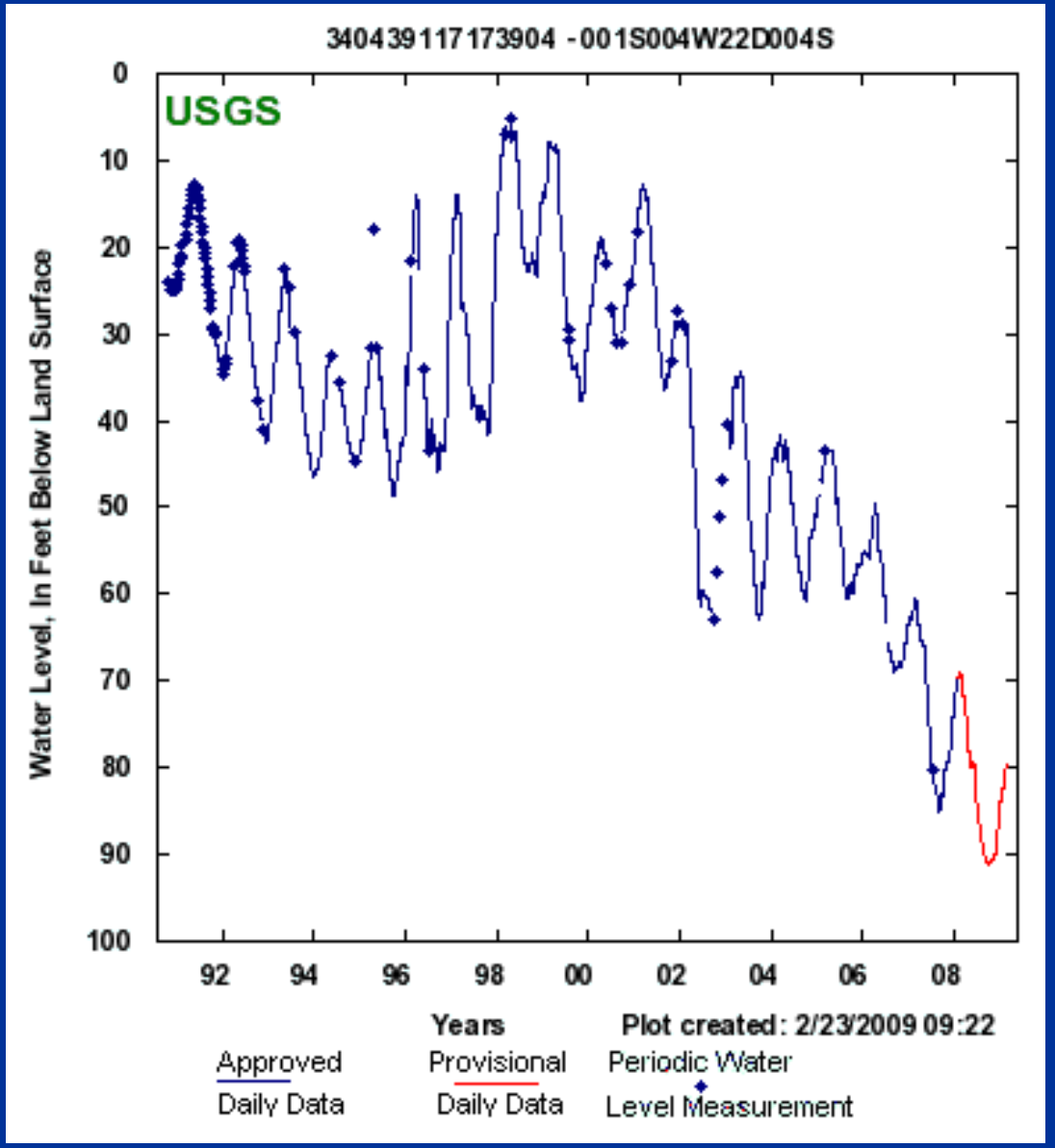
View month/year statistics

**What is "Baseline"?**

**How are levels changing?**

# Site Pages: Hydrographs

- Various options
- Combined data types
- Download data



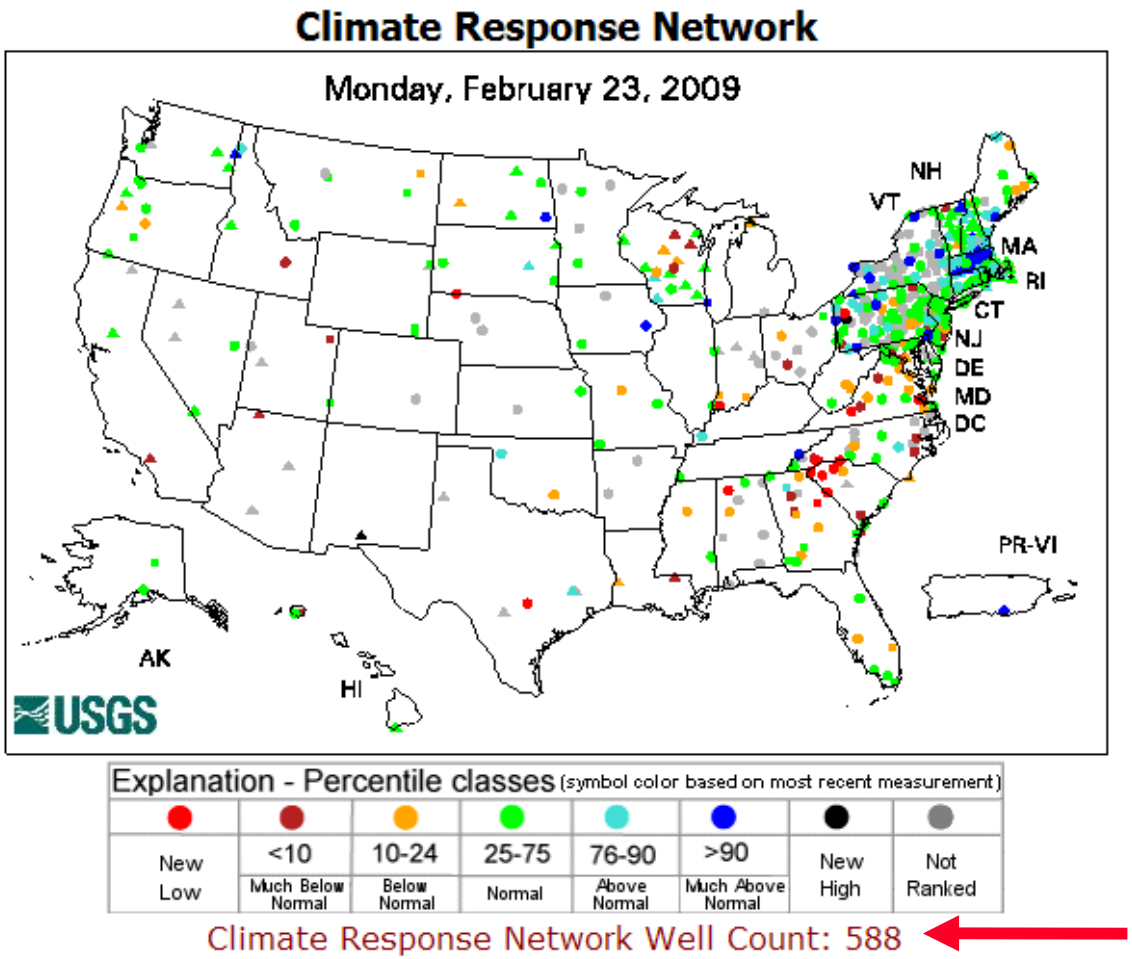

What is “Baseline”?

How are levels changing?

# Site Pages: Satellite Map

# Climate Response Network

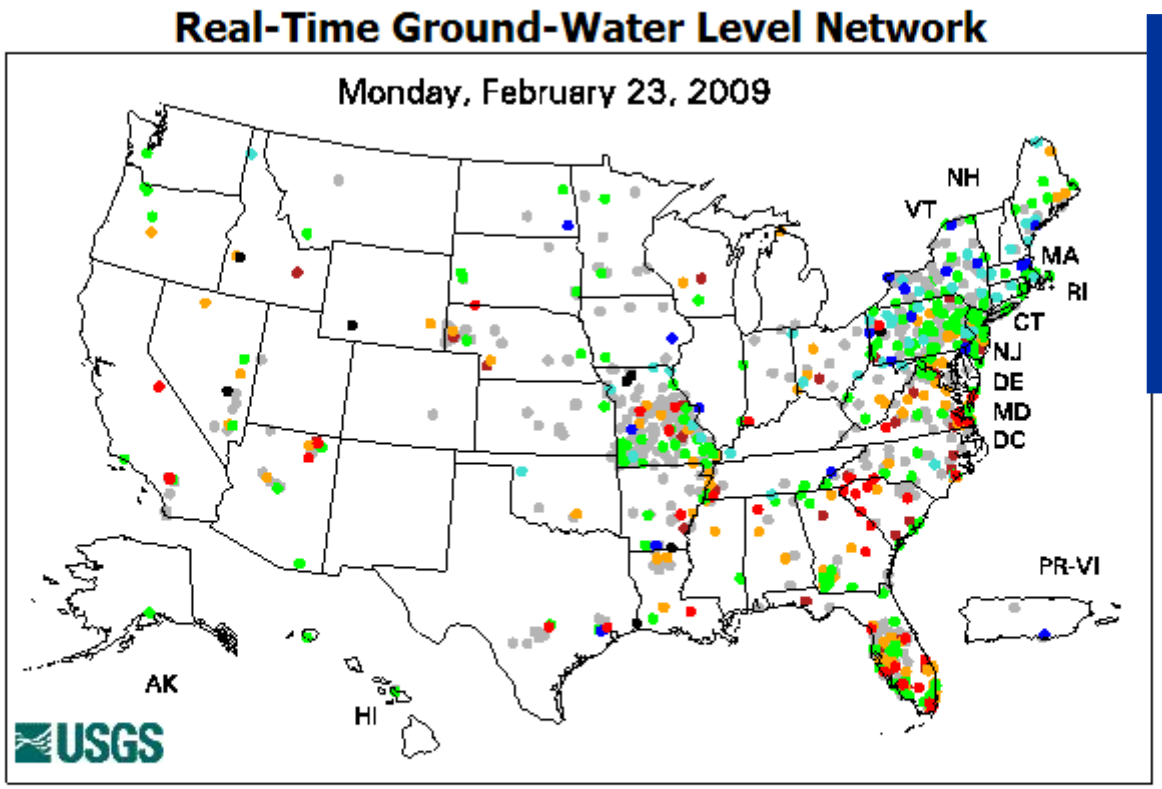
**Ground-Water Watch**




- Water table aquifer
- Limit pumping
- Limit surface water
- Long-term access
- Won't go dry
- Periodic or instrumented wells

# Real Time Network

**Ground-Water Watch**




| Explanation - Percentile classes (symbol color based on most recent measurement) | | | | | | | |
|---|---|---|---|---|---|---|---|
| New Low | <10 Much Below Normal | 10-24 Below Normal | 25-75 Normal | 76-90 Above Normal | >90 Much Above Normal | New High | Not Ranked |

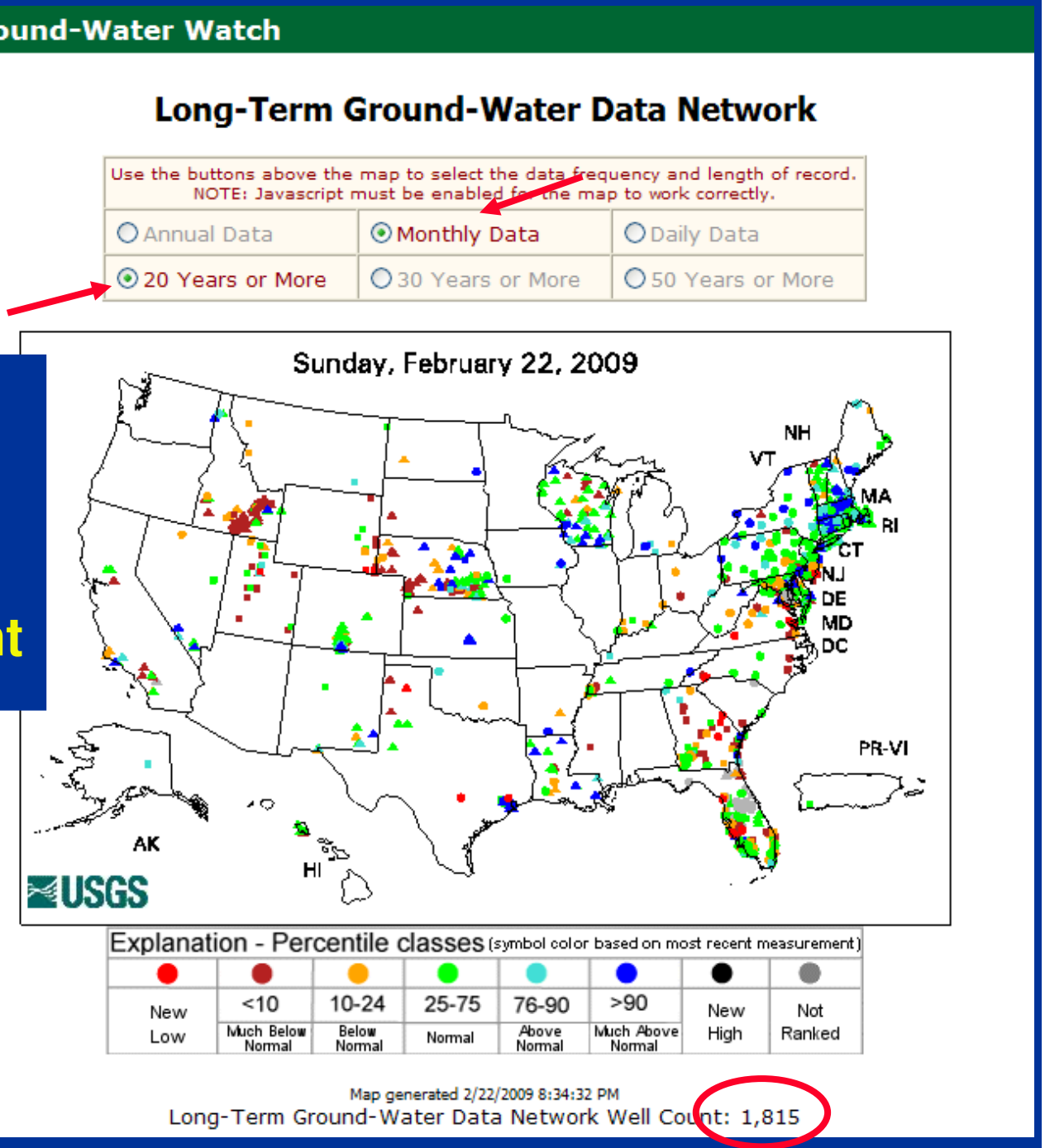
Real-Time Ground-Water Level Network Well Count: 1128

- Continuous, real-time instrumentation
- No other criteria

# Upcoming Product

## Long-Term Data

- Climate Change
- GW Modeling
- GW Management



## California Long-Term Daily Data Network
## Monthly Data, 30 Years or More

Use the buttons above the map to select the data frequency and length of record.
NOTE: Javascript must be enabled for the map to work correctly.

| Annual Data | Monthly Data | Daily Data |
|---|---|---|
| 20 Years or More | 30 Years or More | 50 Years or More |

Hover mouse over site for information.
Click site symbol to open page with well information.


Explanation - Percentile classes (symbol color based on most recent measurement)

| New Low | <10 Much Below Normal | 10-24 Below Normal | 25-75 Normal | 76-90 Above Normal | >90 Much Above Normal | New High | Not Ranked |
|---|---|---|---|---|---|---|---|

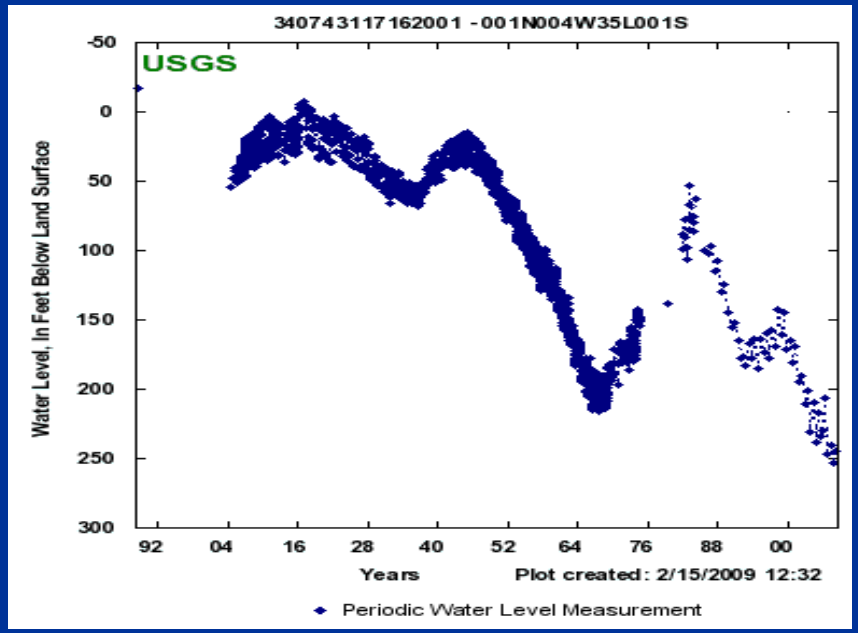
Map generated 2/22/2009 7:18:50 PM

Ground-Water Watch Help Page

Note: Color shading in the table below indicates multiple wells that plot as a single point on the state location map above.
Note: BLS = Water Level in Feet Below Land Surface, AVW = Water Level in Feet Above Vertical Datum

| Map Index | Site ID | Site Name | Start Date | Most Recent Value | Date | Well Depth | Local Aquifer |
|---|---|---|---|---|---|---|---|
| ▲ 1 | 340535117573501 | 001S010W07R002S | 6/17/1932 | **185.28** BLS | 12/3/2008 | 196.2 | |
| ▲ 2 | 340743117162001 | 001N004W35L001S | 6/30/1888 | **245.16** BLS | 4/17/2008 | 256.0 | |
| ▲ 3 | 342506119423801 | 004N027W21B001S | 7/15/1931 | **37.55** BLS | 12/8/2008 | 350.0 | |
| ▲ 4 | 343943120252201 | 007N034W26H003S | 3/9/1950 | **56.35** BLS | 3/11/2008 | 66.9 | |
| ▲ 5 | 344749119265301 | 008N024W08L001S | 1/26/1950 | **49.32** BLS | 3/31/1993 | 144.3 | |

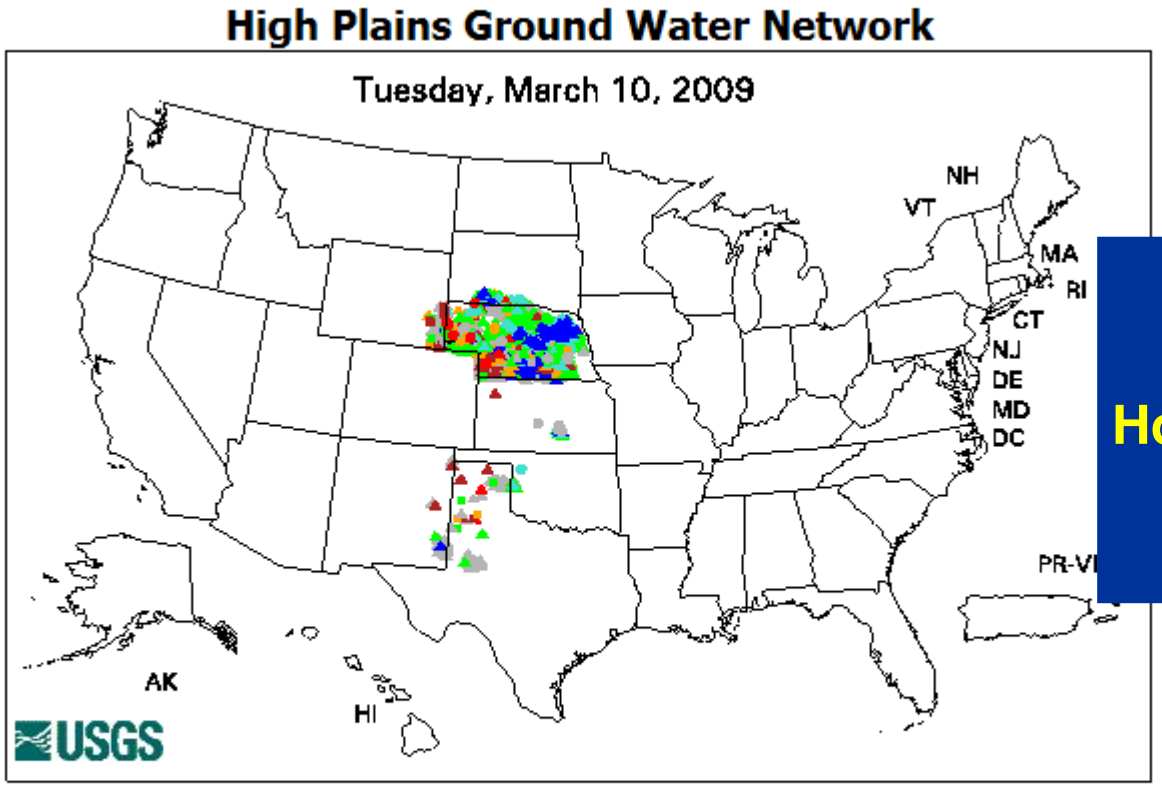
# 5 Wells in California With at least 30 years of data, and at least monthly measurements




# 1888; 1905

# High Plains Aquifer

**Ground-Water Watch**




| Explanation - Percentile classes (symbol color based on most recent measurement) | | | | | | | |
|---|---|---|---|---|---|---|---|
| New Low | <10 Much Below Normal | 10-24 Below Normal | 25-75 Normal | 76-90 Above Normal | >90 Much Above Normal | New High | Not Ranked |

High Plains Ground Water Network Well Count: 4331

**What is "Baseline"?**

**How are levels changing?**

**…..by aquifer**

# Potential Discussion Topics:

- Comparing SW and GW
- How does this report address the ground-water issues in the Coastal Network?
- Levels versus Quality
- Concentrations versus Loads
- Major aquifers versus local aquifers
- Analytes and Methods

# Comparing SW and GW

| Categories | Surface Water | Ground Water |
|---|---|---|
| Agency Focus | NOAA, USEPA | USGS, USEPA |
| Delineation | HUC/Watershed | Aquifer |
| Spatial Extent | 1D or 2D some 3D | 3D/multiple layers |
| Sampling Frequency | Faster movement | Slower movement |
| Water Levels | Flooding & Storage | Stored Quantity |
| Cross-Over Key Factor | Saltwater Intrusion | Base Flow to Surface Waters |
| Public Attention Factor | Urban Dependence | Rural & Agriculture Dependence |
| Sampling Access | Visible, Easy | Not Visible, Difficult |
| Statistical Sampling Design | Mature, Often | Some, Seldom |
| Real-Time & Time-Series Sampling | Maturing | Increasing |
| WQ Drivers | CWA, OSA | SDWA, UIC, CERCLA/RCRA, CWA? |
| Key WQ Problems | D.O./hypoxia | Nitrogen, toxics, Natural, saltwater intrusion |
| Key quantity problems | Floods, drought, sea level rise | Sustainable yield |

# Potential Discussion Topics:

- Comparing SW and GW
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- Analytes and Methods